ID 412C: Enhancing Human Interface Experience by Adding Haptics

David Yuan (Sr. Product Marketing Manager)

12 & 13 October, 2010

NASDAQ: IMMR

Version 1.1
Mr. David Yuan

- Sr. Product Marketing Manager
  - Responsible for market penetration & development within Immersion Corporation for Touch Sense® haptics feedback systems into touch screen/surface device markets

- Previous Experience
  - Over 15 years experience in marketing, business development and sales of semiconductor and electronics systems at several companies, including most recently at AOpen and previously at Zoran Corp., Acer Lab Inc., and Realtek Semiconductor serving consumer and vertical applied computing markets
In the session 110C, Renesas Next Generation Microcontroller and Microprocessor Technology Roadmap, Ritesh Tyagi introduces this high level image of where the Renesas Products fit. The big picture.
This is where our session, ‘412C Enhancing Human Interface by Adding Haptics’ is focused within the ‘Big picture of Renesas Products’
Here are the MCU and MPU Product Lines, I am not going to cover any specific information on these families, but rather I want to show you where this session is focused.
Immersion’s TouchSense technology enables tactile feedback to touchscreens and touch surfaces.

<Click>

**Notes for Devcon Positioning Slide:** There’s a lot of vital information on this slide, which spotlights the Renesas MCU/MPU product lines recommended for new designs. Perhaps the best way to discuss this material is to cover it from a very high level.

Since the merger, we have scrutinized the needs of our global markets, reassessed our strengths, and implemented a business strategy focusing on supporting the ‘ubiquitous computing’ paradigm. This insightful concept — often abbreviated as ‘ubicomp’, and sometimes termed ‘pervasive computing’ or ‘ambient intelligence’ — was introduced by Mark Weiser of Xerox in 1988.

Ubiquitous computing refers to a new genre of computing, a worldwide electronic environment in which computer-controlled products completely permeate the life of end users around the globe. Obviously, many types of products and an enormous range of applications are encompassed by this paradigm, all driven by human ingenuity, engineering creativity and marketing expertise. To one extent or another, people everywhere are already beginning to enjoy the first wave of benefits of the concept’s reality.
Mobile Phone - Provide Immersion touch feedback response for onscreen interactions. Make typing on the virtual QWERTY keys easier and faster with touch feedback

- Complex non-linear vibrations - Touch prelocation
- Image adjustment
- List scrolling
- List ends
- Push and play characteristics. Typing, pinching

MP3 - Further improve the personal entertainment experience. Improved haptic touchscreen interface

Automotive - Force Feedback enhances driver experience and safety. Lexus RX450h Remote Touch controller features haptic feedback for easy use of entertainment and navigation systems. Use haptics to provide intuitive and ergonomic control over a conveniently positioned display

Printer - Provide unique and customizable, touch feedback effects such as printer adjustments. Deliver intuitive and unmistakable confirmation for user preferences like toner and collation options. Replace distracting audio feedback with quiet haptic effects in quiet office environments.

White goods/appliance - Streamline selecting a temperature or cooking time providing intuitive and unmistakable confirmation. Improves safety by overcoming distractions.
Haptics Is The Future Of Digital Technology

Immersion brings a full fidelity haptic experience into the controls to complete the user’s loop of reflex and instinct, linking action to reaction for greater enjoyment, accuracy, and safety. The result is less clutter, faster learning, and greater awareness.

More than sight and sound, touch is the most powerful connection between humans and our world, linking “action and reaction,” providing unmistakable confirmation of our actions with reactions that are innately and automatically understood, not just seen or heard.
Agenda

- Company Introduction
- Market & Opportunity
- TouchSense® 2000 Series
- TouchSense® 2000 Mechanical Overview
- TouchSense® 2000 Electrical Overview
- Q & A
Key Takeaways

By the end of this session, you will be able to:

- Recognize the value of Haptics
- Understand how the Haptics system works
- Identify where the Haptics solution should be used
- Plan on developing & implementing the haptic system
Company Highlights

The Haptics Company

Technology Leader
- Developing haptics solutions since 1993

Established in Large and Rapidly Growing Markets
- TouchSense in 350+ M devices
- Opportunity: 2 B devices per year

World Class Customer Base
- Samsung, Nokia, LG, Sony, Lexus, BMW, CAE

Worldwide Support
- Offices in UK, EU, Korea, Taiwan, Japan, US & Canada

Strong IP
- 900+ granted and pending patents
- Proven ability to defend IP
Haptics – The Science of Touch
TouchSense Brings Digital Devices to Life with Touch Feedback

- **Touch Feedback Allows You to Feel**
  - The keys on a virtual keyboard
  - Button press confirmation silently
  - Cool effects in games
  - Scrolling and swiping
  - Tissue vs. bone in surgery
- **Two Types of Touch Feedback**
  - Tactile Feedback on touch surfaces and touch screens
  - Force Feedback on physical devices (eg. steering wheels, joy sticks, rotary knobs, surgical tools)

• Immersion TouchSense technology enables haptic feedback for touch screen, touch surfaces, and buttons. Haptic feedback allows for a more intuitive, engaging, and natural experience for the user. Haptics can improve the user interface by making on-screen buttons feel like they press and release; by improving the usability of sliders, scrolling list, and list end stops; and by providing attention-getting tactile components for alarm and error conditions. TouchSense tactile sensations combine well with audio feedback and graphics to create a more immersive, complete and intuitive multisensory experience.
Large and Rapidly Growing Markets
Touch Screens and Surfaces Driving Haptic Adoption

- Market drivers include Mobile phone, Automotive, Consumer, Medical, Gaming, Commercial
• The worldwide sales of touchscreen mobile devices is expected to surpass 362.7M units in 2010.

• Touchscreen enabled application products is expected 800M units by 2013.
• 377 million touch screens shipped for mobile phones in 2009, a 62% shipment share in 2009; expect 2010 to reach 531 million.
• Touch penetration in mobile phone will reach over 57% in 2016
World Class Customers and Partners

Leveraging a Best-in-Class Ecosystem

<table>
<thead>
<tr>
<th>OEM Customers and Brands</th>
<th>Semi-conductor</th>
<th>Component</th>
<th>Solution Integrator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobile</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PANTECH, Samsung, LG, NOKIA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gaming</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SONY, Logitech, Microsoft</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Automotive</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOYOTA, VW, BMW, JAGUAR</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Commercial and Consumer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Samsung, MAIATA, NXP</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Immersion works with Tier 1 customers and teams up with best-in-class ecosystem partners. Renasas MCU is now vastly being used for the TS1000/TS2000 series haptic solution in the field.
Compelling Value Proposition

- **Emotional Value**
  - Transforms the User Experience
  - Excites the Senses
  - Restores "Mechanical" Feel

- **Functional Value**
  - Improves Safety
  - Expands Usability

- **Transforms the User Experience**
  with unique and customizable touch feedback effects
- **Excites the Senses**
  in games, video and music
- **Restores "Mechanical" Feel**
  providing intuitive and unmistakable confirmation
- **Improves Safety**
  by overcoming distractions while driving or performing a medical procedure
- **Expands Usability**
  when audio and visual feedback are ineffective
A single touch panel can replace many mechanical buttons, switches, and knobs, and provide increased communications with user, but fails to deliver the tactile response you expect; however, touch controls with touch feedback fills this gap.

Touch feedback improves task performance, increase user satisfaction, and supplies a greater sense of realism and enjoyment.
• **Cost-effective Compelling Haptics Effects** to improve the user experience in mass market device

• **Drop-in Haptic Processor** from leading IC manufacturer and porting available for custom processor

• **Streamlined Haptic Effects** library allows designers to readily select compelling haptic effects through a single command API that is tailored to a range of user interface elements

• **I/O Interfaces** for mass market devices: I2C, SPI, GPIO

• **Lower Power Consumption** Minimizes drain on battery life

• **Proven Mass Market** Suppliers for inertial actuators and amplifiers enable a reliable solution for mass market devices
• TouchSense 2000 Family – TS2000/TS2100. TS2100 with rich UI support with alert and gesture effects for touchscreen market.
• Haptics differentiates user experience across vast array of products in the market segments of mobile, consumer, automotive, gaming, medical and commercial.
The TouchSense® Design Kit – 2000 Series

Part number: TS-DKIT-2000

- The TouchSense Design Kit – 2000 Series includes electromechanical components and documentation that enables OEMs, ODMs, and system integrator to quickly evaluate and experience rich tactile feedback in small touch screen products.

- Kit Components include:
  - Haptic Sampler Board
  - Electromechanical Actuators
  - Control Prototyping Modules
  - Technical Documentation

- How to get started with Renesas-Immersion haptic solution?
- The TouchSense Design Kit-2000 Series is designed to assist in implementing haptics in a small touchscreen or touch-sensitive control panel.
Question

**Question 1:** What is the part number of the TS2000 Design Kit based on Renesas-Immersion solution?

**Answer:** TS-DKIT-2000
Why Inertial Actuation?

- Suitable for small screen applications
- Compact form factor
- Low Power
- Low Component Cost, Driven by High Volumes
- Multiple Suppliers
- Good Haptic Performance
- Proven Technology in tens of millions of Mobile Phones

- Current recommended actuators include Sanyo, Jinlong and Johnson Electric. Eccentric rotating mass consists of a brush or brushless actuator with eccentric or off-center mass, mass attached to the output shaft. When driven by DC voltage, 2-D oscillating force is produced.
Haptic Effects Library

"Plug and Play" Effect Library

- Designers can select over 100 compelling haptic effects through a single command API that are tailored to a range of User Interface elements including:
  - Touch Gestures:
    - Tap
    - Double-tap
    - Swipe
    - Spread
    - Pinch
    - Slide/drag
    - Long press
  - Scrolling through lists
  - Alert
  - Click
  - Buzz
  - Transitions
  - Pulse

- TS2000 has 14 haptic effects and TS2000 has 115 compelling haptic effects
TS200 Series
Mechanical Overview
Suspension Design Process

- Determine suspension type based on hardware type
- Determine actuator to use based on hardware mass
- Design suspension based on points above
- Test and reiterate as needed for consistent touch playback

• Screen-Isolated Haptics & whole-device haptics.
• Small, medium and large depending on screen/body mass
• Haptics performance evaluation
Screen Suspension Type

Two scenarios:
- Haptic effects isolated to screen (desktop, in-dash, large screens) → need relative motion between TS/display & housing
- Haptic effects coupled to screen & housing (hand-held devices) → need stiff connection to all housing

Note: Exact mechanical configuration is application specific.

- If the primary usage of the device is handheld, a whole device haptics design is recommended
- If the primary usage of the devices is not handheld, a floating screen design is recommended
- If the total mass of the device over 300grams, a floating screen is generally preferable, if possible.
In the non-suspended haptics system or “whole-device” haptics, the haptic effect is pretty much on the whole system as seen from the measurement.
• In the suspended haptics system, haptics effect is focused on the screen only as you can see from the measurement below
To determine if Fixed mounting is appropriate, use the following:

- If the total mass of your system is < 150g, a fixed mounting is recommended.
- If the total mass of your system is between 150g and 300g, use the mass ratio guideline of Fixed Mass/Suspended Mass < 3 to determine if fixed mounting is recommended.
- If the total mass of your system is over 200g, Immersion recommends suspending the touch sensor (touchscreen), if possible. Fix the display itself to the rest of the device and add suspension between the sensor and display.
Grommet Suspension Overview

- ME Team has put much effort into the development of grommets for Floating Screen Actuation. Advantages over foam include:

  - **Ease of Assembly**
  - **Easily Customizable**
  - **Shock Protection**
  - **Consistency**

- **Ease of Assembly**: Grommet suspensions provide a quick and effective means to assemble a haptic suspension in a production environment.

- **Easily Customizable**: Grommet geometry and material can be customized to each product's needs.

- **Shock Protection**: Because of the nature of mechanical grommet mounting, they are very good at providing shock (drop load) load protection.

- **Consistency**: Because grommets are injection or compression molded parts, they can be manufactured with high tolerance, providing a consistent haptic suspension.
• An example of grommet suspension with display + touchscreen bonded to the carrier
TS2000 Series
Electrical Overview
The primary components in haptic system are haptic processor, the amplifier circuit, and the haptic actuator.
The TouchSense Design Kit-2000 series provides a quick path to developing such proofs-of-concept. Included in the Design Kit is a Haptic Sampler board populated with a supported actuator. TouchSense control prototyping modules and the actuators may be tested and used to drive their corresponding actuators using the Haptic Sampler board.
The TouchSense Control Prototyping Module is a small PCB containing a standalone reference implementation of the TouchSense-2000 series control solution. You can wire it directly to appropriate actuators that you mount on or inside your prototype device. The TouchSense Control Prototyping Module contains a pre-programmed library of tactile effects.

Three protocols are supported for communications/interface between the haptic processor and the system processor: SPI, I2C, and use of GPIO pins on the haptic processor.
• 14/115 unique effect definitions are stored in the TouchSense player and may be triggered via an I2C or SPI interface or GPIO pins of the microcontroller
• The haptic processor contains the Touch Sense Player, Immersion proprietary code that commands the actuator drive circuit to generate the desired effect upon receiving triggers from the host application. The haptic processor receives haptic triggering commands from the system processor and plays the selected effect from the built-in library. The effect is output to the amplifier, which energizes the haptic actuator.
• This is a Renesas/Immersion demo unit based on R8C family of MCU featuring capacitive touch and haptic technology targeting the home automation, medical, white goods applications, & etc.

• R8C in general, is responsible for haptic effect playback and communication to H8SX and R8C/33T

• H8SX basically controls the screen output, resistive touch, sound and communication to R8C...

• R8C/33T basically is the capacitive touch controller, backlight control, and communication to H8SX and R8C
Question

**Question 2:** What are the two screen suspension types for haptic implementation?
Questions?
Innovation

The TouchSense System Components Include:
- TouchSense Player
- Off-The-Shelf Actuator
- Tactile Effects Library for Common TouchScreen Actions
Thank You
Appendix
• Grommet suspension example for touchscreen only.